ESA-032-2 Schreiber Foods, Inc. - Carthage Plant
FINAL PUBLIC REPORT

Introduction
Headquartered in Green Bay, Wis., Schreiber is a privately held dairy company with sales in excess of $3 billion. Its products – which include process, natural, cream and specialty cheese and yogurt – are sold primarily through customer brand distribution programs.

The overall site steam system at the Carthage, MO plant was the focus of a 3-day steam system Energy Savings Assessment (ESA).

Objective of ESA
The main objectives of the ESA were as follows:

- Understand and identify steam system energy savings opportunities for the Carthage, MO plant.
- Demonstrate and use the DOE Steam tools such as the Steam System Scoping Tool (SSST), Steam System Assessment Tool (SSAT) and the 3E Plus insulation software to model the steam system at the plant.
- Assist the plant maintenance team to familiarize and have the ability to use all of the above mentioned tools to identify energy efficiency improvement opportunities at the plant and quantify the potential energy savings associated with the steam system.

Focus of Assessment:
Overall plant-wide steam system

Approach for ESA:
Plant personnel from the Maintenance Department formed the Core Team in this Steam ESA. This core team supports maintenance of plant utility equipment and they will be able to use SSST, SSAT and 3EPlus, on an as needed basis, to evaluate ongoing and future projects.

The ESA core team used the Steam System Scoping Tool (SSST) on the steam system. A detailed plant walk-through covering all the areas of the plant was completed. This included the generation area, distribution system, end-uses and potential condensate return areas.

Detailed combustion analysis of the stack for each of the boilers was done during the ESA. Each boiler was monitored continuously for a period of 4 hours and flue gas analysis readings were recorded at every half-hour interval. Additionally, flue gas analysis was recorded every minute for a period of 30 minutes. This information allowed the ESA core team to determine the combustion efficiency at different load levels. The steam distribution piping was followed until each individual end-use and temperatures were measured using an infra-red temperature gun.

The SSAT and 3EPlus software tools were then used to identify energy and cost saving opportunities. A 1-pressure header SSAT steam system model was used to study the impact of potential improvement opportunities at the plant.

General Observations of Potential Opportunities

The DOE Steam ESA was an effort on the part of the plant to identify any potential energy savings opportunities and quantify them to assist the plant in increasing their energy efficiency. Based on the Steam ESA, steam savings opportunities exist in different areas. These opportunities are described in the sections below:

1. **Improve Boiler Efficiency – Reinsert Turbulators in Boiler (Near term)**
   The boiler is designed for operation with turbulators on the tube-side. Turbulators help to increase the velocity (turbulence) and residence time of the flue gases and hence, enhance the gas-side heat transfer coefficient. This improves the boiler efficiency.

2. **Improve Boiler Efficiency – Reduce Flue gas Oxygen to ~5% (Near term)**
   Current stack gas analysis on the boiler showed that the boiler was operating at an average of 10% flue gas oxygen level. This results in very lean combustion and a stack loss.

   There is an opportunity to implement an automatic oxygen trim controller. An automatic oxygen trim controller has an independent oxygen sensor in the stack and can control the inlet damper or vary the speed of the combustion fan precisely to provide a tight control on the flue gas oxygen . Implementing an automatic oxygen trim controller

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can provide flue gas oxygen levels at ~2-3% which can result in additional energy savings and an increase in boiler efficiency.

3. Implement Feedwater Heat Recovery (Medium term)
After implementing opportunities 1 and 2, stack gas temperatures can be further reduced by implementing boiler feedwater heat recovery. Properly designing and implementing this feedwater recovery exchanger will result in savings on the steam that is currently used to heat the incoming make-up water.

4. Change Boiler Blowdown Rate (Near term)
Based on the conductivities of the blowdown and the feedwater, surface blowdown was estimated to be ~13.5% of boiler feedwater flow. This can be reduced by improving the water treatment at the plant. BestPractices recommends blowdown rates of about 3-5%.

5. Install Blowdown Flash to Low-Pressure Steam (Near term)
There is an atmospheric blowdown flash tank that collects blowdown from the boiler. This tank continuously vents steam to the ambient whenever there is blowdown. This flash steam can be captured and introduced into the atmospheric feedwater heating tank. This would minimize the amount of natural gas that is used to heat the cold make-up water in the boiler. The thermal energy in the vented steam that is lost to the ambient can be captured by introducing the blowdown flash steam via a sparger into the feedwater tank.

6. Add Feed Water Heat Recovery Exchanger using Boiler Blowdown (Near term)
There exists an opportunity for heat recovery from this boiler blowdown. Due to the make-up water demand for steam generation, installing a feedwater heat recovery exchanger using boiler blowdown would recover additional thermal energy. It is recommended that a single pass heat exchanger with blowdown on the tube-side be used for this service.

7. Implement a Steam Leak Maintenance Program (Near term)
It is recommended that the plant adopt a best practices steam leak maintenance program to minimize or "eliminate" potential steam leaks.

8. Implement a Steam Trap Maintenance Program (Near term)
A systematic steam trap maintenance program should be implemented at the plant. This would ensure that steam loss is minimized. The SSAT was used to model the impact of implementing a steam trap maintenance program at the plant.

9. Change Condensate Recovery Rates (Medium term)
We recommend that all the condensate from the steam traps should be collected. Further, condensate receivers and vent tanks should be periodically monitored to ensure that no steam traps have failed.

10. Improve Insulation (Medium term)
There is good overall insulation in the plant but there are opportunities for improvement in the boiler plant.
It is recommended that an insulation energy appraisal audit be performed as a next step. Economic insulation thickness should be calculated for each individual entity. An infra-red thermography on boilers, steam distribution and equipment should be periodically conducted to ensure insulation integrity.

11. Other – Upgrade COP Tanks & Operation (Medium term)
Installing lids or covers on COP tanks will reduce energy loss from convection and will reduce steam loss. Secondly, installing a steam sparger in all COP tanks will distribute steam along the length of the tank rather than a one spot introduction. This will reduce total steam needed by the COP tanks.

12. Other – Install Condensing Economizer (Long term)
With the availability of state-of-the-art metallurgical practices, condensing economizers are now being used in several industrial plants. They have found a niche application in the food processing industry because it has a high demand for hot water. A condensing economizer recovers all the latent heat from the stack and if a direct contact economizer is used, it can provide hot water up to 140°F. This can reduce the steam usage in the plant.

13. Other Opportunities & BestPractices

Boiler plant optimization

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The boiler plant can be optimized by installing an insulated Steam Accumulator. Optimizing the boiler plant will lead to lower maintenance and energy savings. Another optimization strategy is to install a high efficiency (4-pass) boiler. Additional due diligence and engineering feasibility analysis including data recording is required before these opportunities can be implemented.

Monitor and trend utility usage and cost profile
The SSST tool concluded that the steam system profiling area is an opportunity at the plant. Hence, an effort was made to provide the plant with the necessary tools and information to get them closer to observed BestPractices in the field.

Monitor and trend major equipment efficiencies
There is enough instrumentation on all major equipment in the plant to allow for a measure of efficiency. Monitoring and trending equipment efficiency and certain evaluated parameters can be an extremely important tool for fault detection and diagnostics of boilers, chillers, air compressors, heat exchangers, etc. It is recommended that the maintenance team use this data to monitor and trend equipment efficiency and conduct predictive maintenance on as needed basis. During this ESA an attempt was made to identify the major end-uses of steam and quantify them.

Management Support and Comments
The plant provided full support to the ESA Team to capture any and every economically justifiable opportunity. The core team spent three days working with the ESA Specialist.

The definitions for Near, Medium and Long-term are as follows:

- Near term opportunities would include actions that could be taken as improvements in operating practices, maintenance of equipment or relatively low cost actions or equipment purchases.
- Medium term opportunities would require purchase of additional equipment and/or changes in the system such as addition of recuperative air preheaters and use of energy to substitute current practices of steam use etc. It would be necessary to carryout further engineering and return on investment analysis.
- Long term opportunities would require testing of new technology and confirmation of performance of these technologies under the plant operating conditions with economic justification to meet the corporate investment criteria.

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